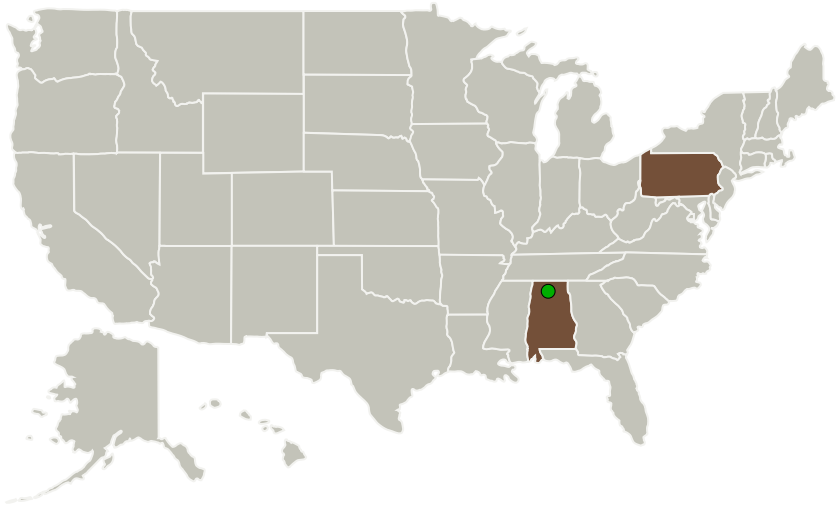
Vapor Chamber with Phase Change Material-Based Wick Structure for Thermal Control of Manned Spacecraft, Phase I

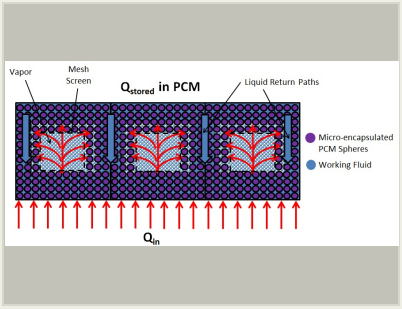
Completed Technology Project (2014 - 2014)

Project Introduction

In response to NASA SBIR solicitation H3.01 "Thermal Control for Future Human Exploration", Advanced Cooling Technologies, Inc. (ACT) is proposing a novel Phase Change Material (PCM) vapor chamber to ameliorate the temperature fluctuations encountered during planetary (or lunar) orbit. The PCM vapor chamber will consist of a packed bed of micro-encapsulated PCM beads surrounded by a two-phase working fluid. The PCM beads will act as both a highly efficient thermal storage medium, as well as a wick structure for capillary pumping of the two-phase working fluid. The two-phase heat transfer by the working fluid increases the effective thermal conductivity of the PCM by a factor of 1000 or more. This approach eliminates the need for embedding thermally conductive metal fins or carbon foam, which typically consume at least 50% of the system mass in traditional PCM heat exchangers. The PCM vapor chamber not only has the potential to exceed a 2/3 PCM mass ratio using paraffin wax, but also provides several advantages over the state-of-the-art, water-based PCM heat exchangers. The concept proposed by ACT will eliminate the need for metal fins and foams, and significantly reduce the mass of non-PCM materials. In addition, the PCM vapor chamber can serve as either a stand-alone thermal capacitor or a dual thermal capacitor/heat exchanger.

Primary U.S. Work Locations and Key Partners





Vapor Chamber with Phase Change Material-based Wick Structure for Thermal Control of Manned Spacecraft Project Image

Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
Advanced Cooling Technologies, Inc.	Lead Organization	Industry	Lancaster, Pennsylvania
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Pennsylvania

Project Transitions

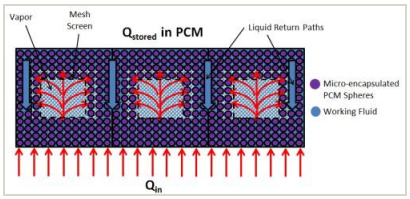
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140540)*

Images



Project Image
Vapor Chamber with Phase Change Material-based Wick Structure for Thermal Control of Manned Spacecraft Project Image *(https://techport.nasa.gov/image/137130)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Advanced Cooling Technologies, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

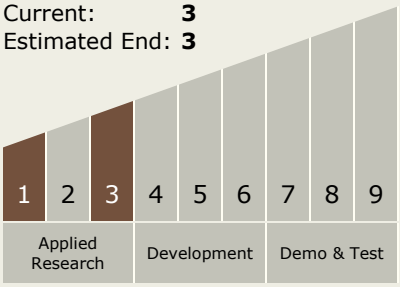
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Taylor Maxwell

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.3 Heat Rejection and Storage

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System